

Session Report

**Solar-Powered Water Solutions
for Climate-Resilient Agriculture:
Lessons from SoLAR**

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Solar Energy for Agricultural Resilience (SoLAR)

The International Water Management Institute (IWMI) has launched the second phase of the Solar Energy for Agricultural Resilience (SoLAR) project, supported by the Swiss Agency for Development and Cooperation (SDC). Running from July 2025 to December 2029, this new phase expands both the geographical and thematic scope of the initiative to strengthen climate resilience and drive agricultural transformation through solar energy. Building on the achievements and lessons of Phase 1 (December 2019 – May 2024) across Bangladesh, India, Nepal, and Pakistan, Phase 2 extends the project's reach to Ethiopia and Kenya, while scaling up interventions in Bangladesh and India. Through South–South collaboration, SoLAR aims to establish solar-powered agricultural systems as a replicable and scalable model for sustainable, socially inclusive, and climate-resilient agriculture across the Global South.

Acknowledgement

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Cover Photo: Women farmers in Kayumer Char, Gaibandha, using water from a micro solar irrigation pump installed on their island by the Rural Development Academy (RDA) to support their farming needs.
(Photo: Tanmoy Bhaduri/IWMI)

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Background

Climate change undermines water resilience by increasing the frequency and intensity of droughts, floods, and unpredictable rainfall, which disrupts the availability and reliability of water resources. This, in turn, threatens livelihoods—particularly in agriculture-dependent communities—by reducing crop yields, limiting access to safe water, and increasing vulnerability to economic and health crises.

Irrigation is a proven strategy to build water resilience in many parts of the Global South, particularly in South Asia. It has reduced exposure to changing rainfall patterns, helped improve yields, and enabled diversification of livelihoods. However, access to irrigation, particularly for women and marginalized farmers, is constrained by several factors. Emerging evidence shows the transformational potential of solar irrigation for livelihoods, agri-food systems and recognizes the agency of women and marginalized groups in climate-resilient irrigation for harnessing livelihood opportunities. Communities that have adopted these systems report higher crop yields, extended growing seasons, and increased income generation. With consistent water supply, farmers can diversify their crops, improve food security, and enhance their economic well-being.

The last decade has seen rapid expansion in uptake of solar technologies in rural areas. Solar-powered pumps to deliver water for drinking and irrigation, solar lighting, solar dryers, and solar cold chains have matured to varying degrees in different regions. The surge in South Asia is driven, at least in part, by ambitious government campaigns in countries such as India with significant subsidy support for solar pumps.

In East Africa, Ethiopia is investing heavily in solarization of agriculture with support mainly from the donor agencies and the government. In Kenya, the private sector has been at the forefront of expanding solar irrigation through pay-as-you-go models and bundled services, supported by partnerships with development partners to improve affordability and scale. However, the optimism is often truncated by questions regarding the actual impacts on mitigation and adaptation. Issues of equity and inclusion in access to and control over solar irrigation pumps (SIPs) remain a systemic challenge to tackle.

Critically, concerns around the potential for over-extraction of groundwater in vulnerable areas remain high. Therefore, the replicability and scalability of solar irrigation have not achieved their full potential. Understanding barriers and opportunities for context-specific and inclusive scaling of solar irrigation requires more in-depth thought. Using examples from IWMI's ongoing work in South Asia and East Africa, this session will brought together policymakers, public and private sector partners, and scientists to exchange ideas and experiences to better understand barriers and opportunities for financing and scaling solar irrigation.

The discussion contributed to identifying concrete commitments and partnerships to advance climate-resilient, inclusive solar irrigation as a pathway toward water security and sustainable agriculture in the Global South.

Objective of the session

The session will explore solar irrigation's role in enhancing climate resilience, water security, and sustainable agriculture in South Asia and East Africa. It highlights low-carbon, climate-smart solutions, and policies for integrating solar irrigation to achieve climate and water goals, ensuring social inclusion and financial viability. The proposed session will explore how solar irrigation technologies can enhance climate resilience, improve water security, and support sustainable agriculture in South Asia and East Africa. As climate change disrupts water availability, smallholder farmers face increasing challenges in accessing reliable irrigation sources. Solar-powered irrigation

pumps (SIPs) offer a low-carbon, climate-smart alternative, reducing dependence on fossil fuels, promoting sustainable food production, and supporting resilient livelihoods.

Through case studies and expert insights, this session demonstrated how integrating solar irrigation into water policies can help countries achieve their climate and water security goals, while ensuring social inclusion and financial viability. In light of growing concerns around the links between solar irrigation and groundwater use in some parts of the Global South, the discussion highlighted lessons from SoLAR’s “Living Labs,” innovative financing solutions, and policy frameworks that promote sustainable water use for agriculture.

The key objectives of this session were to:

- Share evidence and demonstrate key lessons learned from South Asia and East Africa on the effectiveness of solar irrigation as a viable strategy for water and climate resilience.
- Share innovative ideas for mobilizing finance and scaling solar irrigation in an equitable and inclusive manner.
- Discuss strategies to integrate solar irrigation sustainably within water policies while managing groundwater resources.

The session witnessed participation from over 70 attendees, with broad regional representation.



Fabrice Fretz, Deputy Head, Water Section, Swiss Agency for Development and Cooperation (SDC), delivered the opening remarks virtually.

Welcome Remarks

Speaker: *Fabrice Fretz, Deputy Head, Water Section, Swiss Agency for Development and Cooperation (SDC)*

Mr. Fretz welcomed participants and partners to the session and underscored the importance of solar-powered irrigation solutions in advancing climate-resilient agriculture. He emphasized SDC’s commitment to supporting innovative and sustainable water-agriculture approaches, highlighting the need for scalable models and effective knowledge sharing emerging from the SoLAR project across South Asia. He encouraged stronger collaboration among governments, researchers, and development partners to ensure sustainability and broader impact.

The remarks were followed by a [short video](#) introduction to the SoLAR project.

Keynote Address

Speaker: *Nicole Lefore, Associate Director, Daugherty Water for Food Global Institute, University of Nebraska*

Dr. Lefore shared global perspectives on water resilience and livelihoods, drawing lessons from East and West Africa and Latin America.

Key insights:

- Multiple benefits of solar irrigation: Beyond irrigation, solar water solutions support Water, Sanitation, and Hygiene (WASH), agri-food systems, and livestock.
- Decoupling water and energy access: Solar reduces dependency on volatile fuel markets, ensuring stable energy costs and reliable water access.
- Community impacts: Enhanced food and nutrition security, opportunities for diversified diets, and increased income through surplus production.

Scaling challenges and opportunities:

- Persistent difficulties in scaling despite proven benefits.
- Opportunities include innovative financing models, varied system designs, bundling technology with value-chain integration, and non-ownership models such as irrigation-as-a-service.

Policy recommendations:

- Removal of taxes and duties on solar technologies.
- Deployment of blended finance mechanisms to de-risk investment and encourage wider adoption.

Learnings from the SDC–SoLAR in South Asia & East Africa

Speakers:

Darshini Ravindranath – Project Lead, SoLAR; Research Group Leader – CPFP, IWMI

Muluken Adamseged – Project Co-Lead, SoLAR; Deputy Country Representative – Ethiopia, IWMI

Dr. Ravindranath outlined the goals of the SoLAR program:

- Generating robust evidence to shape climate-resilient, gender-equitable, socially inclusive, and groundwater-responsive policies.
- Testing and validating innovative strategies for inclusive scaling.
- Enhancing capacity for sustainable solar irrigation design and implementation.

Key outcomes from Phase 1 (South Asia):

- Gender-inclusive pilots demonstrated women's participation and benefits.
- Innovative financing models reduced entry barriers.

- Low-emission solutions supported clean energy transitions.
- Grid-connection pilots tested net-metering and energy-water integration.
- Capacity building and knowledge sharing strengthened regional dialogue and policy engagement.

Country policy highlights:

India: Findings shared with MNRE expected to inform Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) 2.0 (2027).

Nepal: Alternative Energy Promotion Centre (AEP) revising subsidies to benefit women and smallholders; first grid-connected solar irrigation pump (SIP) pilot initiated.

Bangladesh: Infrastructure Development Company Limited (IDCOL) approved 56 new SIPs, with 39 planned for grid-connection.

Pakistan: Developed SIP sizing tools and solar suitability mapping across three provinces.

Community models:

- Pilots in Madhya Pradesh established community-managed solar lift irrigation and women-led water user associations.
- Financial models included solar-powered rice mills for off-season income diversification.

Dr. Adamseged introduced Phase 2, which extends SoLAR's scope to East Africa, guided by four strategic outcomes:

- Evidence-based policy design.
- Accelerated finance mobilization.
- Capacity building and knowledge exchange.
- Solar scaling through Living Labs for real-world, community-driven experimentation.

The East Africa expansion tailors South Asian lessons to new contexts, with an integrated approach emphasizing inclusivity and sustainability.

Panel Discussion: Scaling and Financing for Resilient and Inclusive Solar Adoption

The panel discussion, moderated by **Ms. Isis Palay, Consultant, CGIAR**, brought together diverse perspectives from government, private sector, and research institutions to explore opportunities and challenges in scaling solar-powered irrigation for climate-resilient agriculture.

Hizkyas Dufera, Senior Energy Advisor at the Ministry of Irrigation and Lowlands, Ethiopia, highlighted Ethiopia's ongoing transition from diesel-based to solar-powered irrigation. He explained that this shift is being approached at multiple scales, from large irrigation schemes to small-scale micro-irrigation systems. Hizkyas noted that solar irrigation in Ethiopia is not only an adaptation strategy to address climate change but also a key mitigation measure to reduce reliance on fossil fuels. He emphasized ongoing government policy efforts, including the creation of a national data repository for irrigation pumps, the use of technology to track efficiency, and a strong push for equitable access. Particular attention, he stressed, is being given to micro-schemes of less than 25 hectares, with priority extended to women, youth, and marginalized groups. These initiatives are aligned with Ethiopia's broader national irrigation strategy, which integrates inclusivity, sustainability, and climate resilience.

Cindy Shigoli, Head of ESG at SunCulture, underscored the crucial role of the private sector in driving innovation and scaling solar irrigation. She emphasized that businesses like SunCulture operate at the water–energy–food (WEF) nexus, ensuring that irrigation systems contribute not just to water and energy access but also to food security and efficient agricultural production. Cindy highlighted the company’s focus on inclusive and affordable business models, particularly those designed to reach women and marginalized farmers. She stressed that affordability and accessibility must be addressed simultaneously with technological, policy, and financial innovations. To unlock greater investment, she called for innovative financing mechanisms, such as pay-as-you-go schemes, blended finance, and guarantee instruments that reduce risks for both farmers and investors. She also underlined the importance of partnerships with governments, donors, and multilateral organizations in creating enabling policy and financial environments that can accelerate adoption.

Alok Sikka, IWMI’s Country Representative for India and Bangladesh and Senior Fellow, brought in the perspective of research and development, emphasizing the importance of applying a water–energy–food (WEF) nexus approach in scaling solar irrigation. He noted that focusing only on water management is insufficient and that integration with food production systems and energy policy is essential for long-term sustainability. Drawing on IWMI’s work, he highlighted tools such as the solar irrigation pump sizing tool and solar suitability mapping, which provide valuable data for informed decision-making. Dr. Sikka stressed the importance of groundwater modeling to ensure that solar irrigation does not inadvertently accelerate groundwater depletion. He also discussed the need for incentive mechanisms to encourage sustainable practices among farmers. Importantly, he contrasted regional approaches, noting that in Africa, solar irrigation has largely been farmer-led and donor-driven, while in South Asia it has been primarily government-supported. He argued that these differences present opportunities for South–South knowledge exchange, where countries can learn from each other’s experiences, refine business models, and strengthen value chain linkages to accelerate scaling.

The discussion underscored a common theme: scaling solar irrigation requires not only technological solutions but also enabling policies, innovative financing, inclusive business models, and cross-regional knowledge sharing. Together, the panelists highlighted how governments, private sector actors, and research institutions can collaborate to ensure that solar irrigation adoption is resilient, inclusive, and sustainable.

Way forward

In her concluding reflections, Ms. Isis Palay thanked all speakers, panelists, and participants, along with Stockholm International Water Institute for hosting the online session. She emphasized that the session showcased the transformative role of inclusive, resilient, and sustainable solar irrigation in advancing climate-resilient agriculture. She underscored the importance of continued collaboration among governments, private sector, researchers, and communities to translate evidence into practice and ensure lasting impacts on water security, food systems, and livelihoods.

Annex A. – Agenda

24 August 2025 | 10:00 – 11:00 CEST | Online | World Water Week in Stockholm

Time	Topic	Speaker
10:00 – 10:05	Welcome & Introduction	Fabrice Fretz Deputy Head, Water Section, Swiss Agency for Development and Cooperation (SDC)
10:05 – 10:15	Keynote: Why Solar Matters for Agricultural Water Resilience and Climate Adaptation	Nicole Lefore Associate Director, Daugherty Water for Food Global Institute, University of Nebraska
10:15 – 10:25	Learnings from the SDC–SoLAR in South Asia & East Africa	Darshini Ravindranath Project Lead – SoLAR, Research Group Leader – Climate Policies, Finance and Processes (CPFP), IWMI Muluken Adamseged Deputy Project Lead – SoLAR & Deputy Country Representative – Ethiopia & Researcher – Innovation Scaling, IWMI
10:25 – 10:45	Panel Discussion: Scaling and Financing for Resilient and Inclusive Adoption of Solar for Agriculture	Hizkyas Dufera Senior Energy Advisor, Ministry of Irrigation and Lowlands, Government of Ethiopia Cindy Shigoli Head of ESG at SunCulture Alok Sikka Country Representative – India & Bangladesh / Senior Fellow, IWMI
10:45 – 11:00	Q&A session and closing	Isis Palay Consultant, CGIAR

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The International Water Management Institute (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 17 countries and a global network of scientists operating in more than 55 countries.

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